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Impact of Automobile Emissions on the Productivity of C*rocus sativus* L.

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ABSTRACT: Effect of automobile pollution on the productivity of *Crocus sativus* was studied for one year time period (October 2005-April 2006). The parameters which were analyzed viz total chlorophyll, carotenoids, leaf area, plant height, corm size, corm weight, corm yield, biomass, flower production, and length of stigma and style, showed a remarkable decrease as compared to control. Total chlorophyll ,carotenoids and leaf area decreased by approximately 40%, plant height by 36%, fresh biomass by 33%, dried biomass by 25%, corm yield by 29%,corm number by 32%, corm size by 33%,flower production by 33%,length of stigma+style by 23%,fresh weight of flower by 15% and dried weight of flower by 14% respectively.

Key words: Automobile emissions, Productivity, *Crocus sativus*, Suspended particulate matter, SO_2, NO_2

INTRODUCTION

Saffron (*Crocus sativus*.) is highly prized as one of the best natural food flavorings and coloring substance having general panacea properties. Chief pigment of saffron is its yellowish red glycoside crocin. *Crocus sativus* is a perennial low growing herb with globular corms ranging from 0.5 to 5.0 cm in diameter. The sizes of the **corm** have a profundal effect on the productivity of *Crocus sativus* (Ingram 1969, Madan *et al.* 1996). Besides corm size saffron production is also influenced by photoperiod, humidity, atmospheric composition, etc. (Madan *et al.*, 1996). The atmospheric composition is altered by human activity like air pollution. As per estimated automobile emissions is the primary source of air pollution (Sivasamy and Srinivasan, 1997). The polluted air may have profundal affect on the growth and development on vegetation, because gases enter the leaves during the normal course of gaseous exchange and cause blocking of stomata, chlorophyll degradation, less starch synthesis, damage to leaves and other tissues, growth reduction and ultimately decline in crop yield (Grime1970, Well burn *et al.*, 1981, Bates and Farmer, 1992, Agarwal *et al.*,2003, and Yi *et al.*,2005).

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MATERIALS & METHODS

The entitled work was carried out from October 2005 to April 2006. Pampore karewa (Jammu& Kashmir,India), where it is cultivated as a cash crop, was selected as a site to study the impact of auto emission on saffron productivity .The crop production in this region had faced a decline from past few years. One of the factors which have been associated with it is the chronic exposures of *Crocus sativus* to automobile emissions. Following are the methods which were adopted to monitor air quality of the region and to analyze different plant parameters High volume air sampler was used to monitor NO_2, SO_2 and suspended particulate matter .NO_2 estimation was done by Merryman *et al*. (1973) method, SO_2 was estimated by West and Gaek (1956) method, and suspended particulate matter was estimated by filtration method. Chlorophyll and carotenoids were extracted in 80% acetone and readings were measured at 645,663,510 and 480 nm and calculations were made according to Arnon (1949) using absorption coefficient. Leaf area was measured by using a long graph paper. The plant height was measured as the maximum length of aerial shoots arising from the apical notes of a corm from the soil surface to its apex. Corms were dug from each quadrate of Im x Im. After removing the soil from the corms they were weighed and recordings were made. The number of corms were also counted and noted down. The dug out corms from a given quadrate of Im x Im were taken out, cleaned and later measured for its diameter with the help of a fiberglass tape. Number of flowers was estimated by harvesting the flowers present in an Im x Im quadrate. The stigmas and styles were then shaved off and measured for its length using a centimeter scale. The flowers after weighed for fresh masses were then dried in sunlight until uniform dried weight was obtained.

RESULTS & DISCUSSION

The effect of automobile emission on the productivity of *Crocus sativus* is summarized in Tables 1, 2 and 3 and Figs. 1-8. The results of decline in average annual productivity due to automobile emissions at various sites along roadsides are in agreement with each other. The factors most likely to influence the productivity were the synergetic effects of NO_2, SO_2 and SPM (Table 1) and the winter conditions that prevailed during winter times, this is in agreement with the finding of Asheden and Mansfield (1978), Murray *et al.* (1992) and Bell and Treshow (2002). The effect of auto emission (NO_2, SO_2 & SPM) had a detrimental effect on the amount of total chlorophyll and carotenoid as shown in Table 2. Total chlorophyll & carotenoids showed a declining trend along road rides as compared to control. The results are in conformity with the findings of Neubert *et al.* (1993), Tingey *et al.*(1971), Legge *et al.*(1998), Pratibha & Madhu (2000), Hao *et al*.(2002). Agarwal *et al.*(2003) and Yi, *et al.*,2005.

The data (Table 2) reveals that automobile emission also had a detrimental influence on the corm size, corm number, and corm yield along roadside. The declined trend along road sides as compared to control is attributed to the fact that the *Crocus sativus* being a perennial herb is susceptible to pollution and shows reduced photosynthetic activity and less storage of starch in corm. This is in agreement to the results of Well burn *et al.*(1981), Frevert (1984), Modi *et al.*(1992), Legge (1996), Vorobeichik (2002) and Hao *et al.* (2002).

Table 1. Ambient air monitoring along roadside From October 2005-April 2006

S.No	Parameters	Permissible limits Mean values	Recorded concentration
1.	SO_2 ($\mu g/m^3$)	30	58
2.	NO_2 ($\mu g/m^3$)	30	84
3.	SPM ($\mu g/m^3$)	100	346

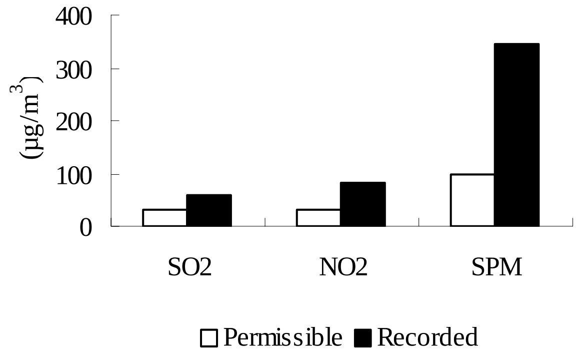

Fig. 1. Comparative ambient air quality

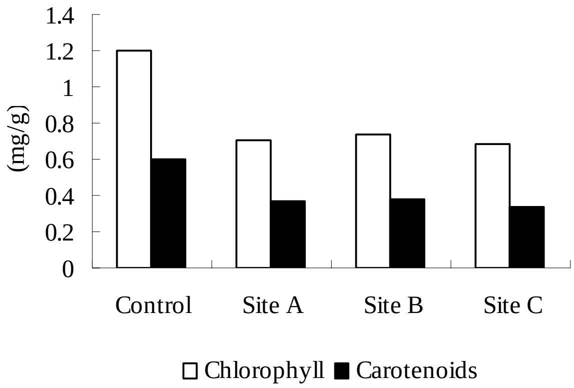

Fig. 2. Concentrations of Chlorophyll and Carotenoids

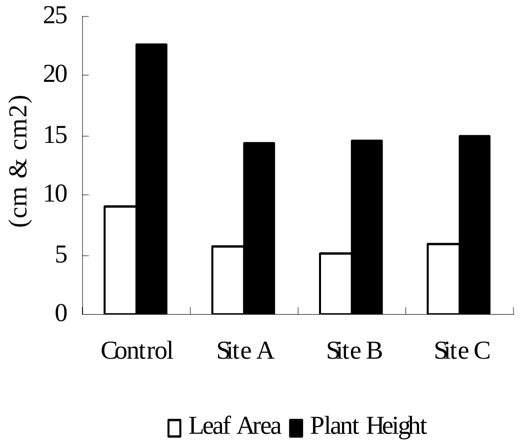

Fig. 3. Leaf and Plant characteristics

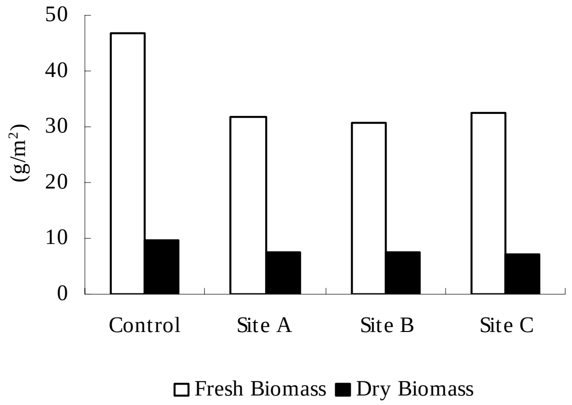

Fig. 4. Fresh and Dry biomass

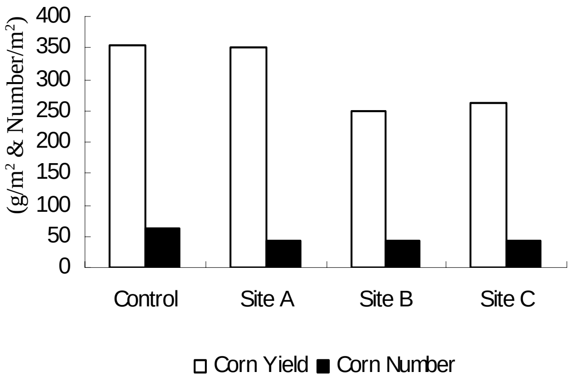

Fig. 5. Corn yield and number

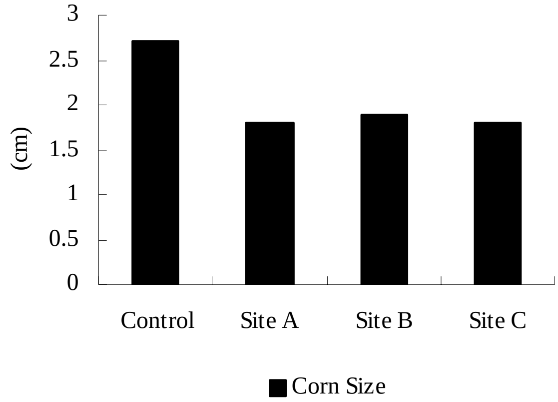

Fig. 6. Corn size

Table 2. Vegetative plant analysis of *Crocus sativus* from October 2005-April 2006

S. No	Parameter	Control	Exposed Sites along road sides		
			Site A	Site B	Site C
		Mean	Mean	Mean	Mean
1	T. Chlorophyll (mg/g)	1.20	0.71	0.74	0.68
2.	Carotenoids (mg/g)	0.60	0.37	0.38	0.34
3.	Leaf Area (cm^2)	9.06	5.74	5.10	5.94
4.	Plant Height (cm)	22.54	14.40	14.50	15.05
5.	Fresh Biomass above ground (g/m^2)	46.85	31.85	30.80	32.57
6.	Dried Biomass above ground (g/m^2)	9.68	7.6	7.4	7.05
7.	Corm yield (g/m^2)	355.71	252.85	248.57	261.57
8.	Corm number (NO/m^2)	62.28	43.4	42.28	42.28
9.	Corn size (cm)	2.72	1.82	1.86	1.81

Table 3. Flower production /m², length stigma + style, fresh weight of Flowers/m² and dried weight of flowers/ m² (October and November 2005)

S. No	Parameter	Control	Exposed Sites along road sides		
			Site A	Site B	Site C
		Mean	Mean	Mean	Mean
1	Flower Production (NO /m²)	34	23.0	22.0	24.0
2	Length of Stigma +Style (cm)	3.96	3.0	3.2	3.0
3	Fresh weight of flowers (g/m²)	3.270	2.800	2.850	2.800
4	Dried weight of flowers (g/m²)	0.483	0.417	0.421	0.414

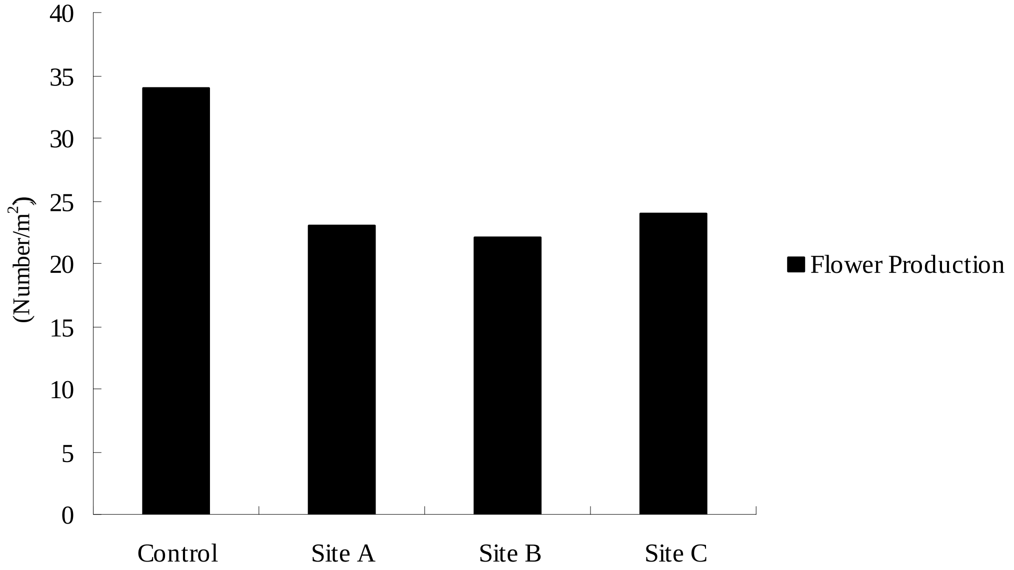

Fig. 7. Flower production at control and exposed sites

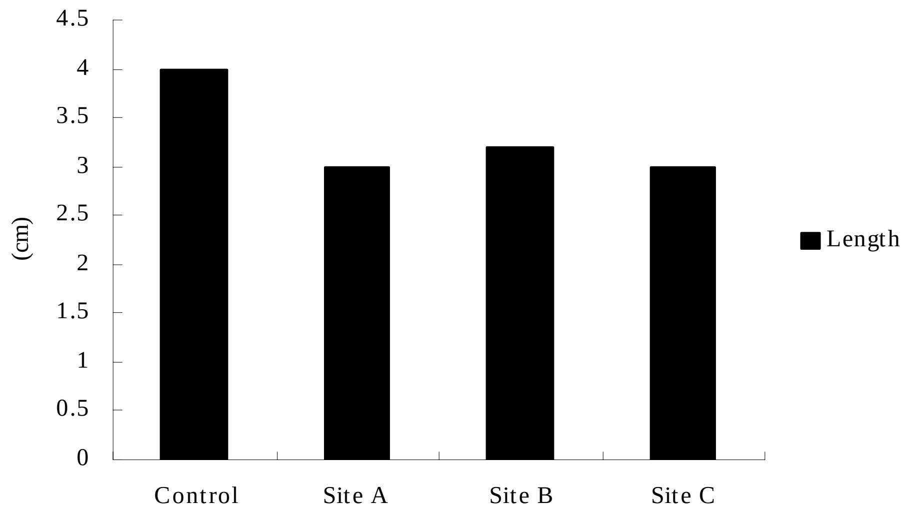

Fig. 8. Length of stigma plus style

CONCLUSION

Plant height, leaf area and biomass is influenced by corm size (Srinivastava, 1963,1964). During the period of study, plant height, leaf area and biomass showed a remarkable declined. These results are in total agreement with the reports of Grime (1970), Pandey (1974), Gilani (1977), Jacobson (1987), Bates & Farmer (1992), Kamalakar (1992) and Agarwal *et al*.(2003).The number of flowers / quadrate and length of stigma + style were highly influenced by auto emissions along roadside. The number of flowers and length of stigma + style is directly related to the corm size and yield. Hence the results obtained are in close proximity with that of Madan *et al*.(1966), Pandey *et al*.(1974), and Munshi and Zargar (1991).

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